# Introduction

## 1.1 Sodium hydroxide:

Sodium hydroxide, also known as caustic soda,orlye, is an inorganic compound with the chemical formulaNaOH. It is a white solid and highly caustic metallic base and alkalisalt which is available in pellets, flakes, granules, and as prepared solutions at a number of different concentrations.

Sodium hydroxide forms an approximately 50% (by weight) saturated solution with water.

Sodium hydroxide is soluble in water, ethanol and methanol, This alkali is deliquescent and readily absorbs moisture and carbon dioxide in air [9]

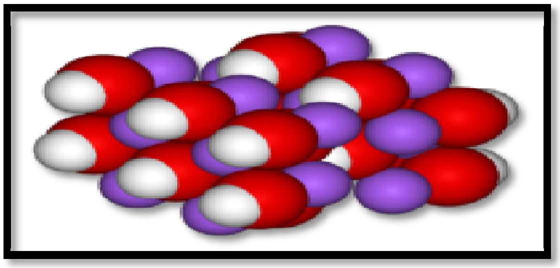


**Figure 1.1: shows the structure of sodium hydroxide(crystal [9]**

### 1.1.1 Identification:

| | |
|---|---|
| CAS number | 1310-73-2 |
| EC number | 215-185-5 |
| RTECS number | WB4900000 |
| Molecular formula | NaOH |
| Molar mass | 39.9971 g $mol^{-1}$ |
| Appearance | White, waxy, opaque crystals |
| Odor | Odorless |
| Density | 2.13 $g/cm^3$ |
| Melting point | 318 °C (604 °F; 591 K) |
| Boiling point | 1,388 °C (2,530 °F; |
| Solubility in water | 41.8 g/100 mL (0 °C)<br>111 g/100 mL (20 °C)<br>337 g/100 mL (100 °C) |
| Solubility | soluble in glycerol insoluble in ether |
| Solubility in methanol | 23.8 g/100 mL |
| Solubility in ethanol | <<13.9 g/100 mL |
| Vapor pressure | <2.4 kPa (at 20 °C) |
| Acidity ($pK_a$) | 13 |

## 1.1.2 Thermo chemistry:[9]

| | |
|---|---|
| Specific heat capacity$C$ | 59.66 J/mol K |
| Std molar entropy$S^{\ominus}_{298}$ | 64 $J \cdot mol^{-1} \cdot K^{-1}$ |
| Std enthalpy of formation $\Delta_f H^{\ominus}_{298}$ | $-427$ $kJ \cdot mol^{-1}$ |
| Gibbs free energy ΔG | -380.7 kJ/mol |

## 1.1.3 Hazards:[8]

| | |
|---|---|
| MSDS | External MSDS |
| GHS pictograms |  |
| EU Index | 011-002-00-6 |
| EU classification |  C |
| R-phrases | R35 |

## 1.2 Properties:

### 1.2.1 Physical properties:

Pure sodium hydroxide is a whitish solid, sold in pellets, flakes, and granular form, as well as in solution. It is highly soluble in water, with a lower solubility in ethanol and methanol, but is insoluble in ether and other non-polar solvents.[9]

Similar to the hydration of sulfuric acid, dissolution of solid sodium hydroxide in water is a highly exothermic reaction in which a large amount of heat is liberated, posing a threat to safety through the possibility of splashing. The resulting solution is usually colorless and odorless with slippery feeling upon contact in common with other alkalis.[16]

### 1.2.2 Chemical properties:

#### 1.2.2.1Reaction with acids:

Sodium hydroxide reacts with acids to produce water and the corresponding salts. For example, when sodium hydroxide reacts with hydrochloric acid, sodium chloride is formed:

$$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O$$

In general, such neutralization reactions are represented by one simple net ionic equation:

$$OH-_{(aq)} + H+_{(aq)} \rightarrow H_2O_{(l)}$$

This type of reaction with a strong acid releases heat, and hence is exothermic. Such acid-base reactions can also be used for titrations. However, sodium hydroxide is not used as a primary standard because it is hygroscopic and absorbs carbon dioxide from air.

### 1.2.2.2 Reaction with acidic oxides:

Sodium hydroxide also reacts with acidic oxides, such as sulfur dioxide. Such reactions are often used to "scrub" harmful acidic gases (like $SO_2$ and $H_2S$) produced in the burning of coal and thus prevent their release into the atmosphere. For example.[9]

$$2\ NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$$

### 1.2.2.3 Reaction with amphoteric metals and oxides:

Glass reacts slowly with aqueous sodium hydroxide solutions at ambient temperatures to form soluble silicates. Because of this, glass joints and stopcocks exposed to sodium hydroxide have a tendency to "freeze". Flasks and glass-lined chemical reactors are damaged by long exposure to hot sodium hydroxide, which also frosts the glass. Sodium hydroxide does not attack iron since iron does not have amphotericproperties .[4]

In 1986, an aluminum road tanker in the UK was mistakenly used to transport 25% sodium hydroxide solution, causing pressurization of the contents and damage to the tanker. The pressurization was due to the hydrogen gas which is produced in the reaction between sodium hydroxide and aluminum:

$$2\ Al + 2\ NaOH + 6\ H_2O \rightarrow 2\ Na[Al(OH)_4] + 3\ H_2$$ [18]

### 1.2.2.4Precipitant:

Unlike sodium hydroxide, the hydroxides of most transition metals are insoluble, and therefore sodium hydroxide can be used to precipitate transition metal hydroxides. The following colors are observed: blue-copper, green-iron (II), yellow/brown-iron (III). Zinc and lead salts dissolve in excess sodium hydroxide to give a clear solution of $Na_2ZnO_2$ or $Na_2PbO_2$.

Aluminum hydroxide is used as a gelatinous flocculent to filter out particulate matter in water treatment. Aluminum hydroxide is prepared at the treatment plant from aluminum sulfate by reacting it with sodium hydroxide.[3]

$$Al_2(SO_4)_3 + 6\ NaOH \rightarrow 2\ Al(OH)_3 + 3\ Na_2SO_4$$

### 1.2.2.5Saponification:

Sodium hydroxide can be used for the base-driven hydrolysis of esters (as in saponification), amides and alkyl halides. However, the limited solubility of sodium hydroxide in organic solvents means that the more solublepotassium hydroxide (KOH) is often preferred.[7]

### 1.2.3 Uses:

Sodium hydroxide is a popular strong base used in the industry. Around 56% of sodium hydroxide produced is used by the industry, 25% ofwhich is used in paper industry. Sodium hydroxide is also used in manufacturing of sodium salts and detergents, pH regulation, and organic synthesis. It is used in the Bayer process of aluminumproduction,In bulk it is most often handled as an aqueoussolution, since solutions are cheaper and easier to handle.

For example, in petroleum industry, sodium hydroxide is used as an additive in drilling mud to increase alkalinity in bentonite mud systems, to increase the mud viscosity, and to neutralize any acid gas (such as hydrogen sulfide and carbon dioxide) which may be encountered in the geological formation as drilling progresses.

Poor quality crude oil can be treated with sodium hydroxide to remove sulfurous impurities in a process known as caustic washing. As above, sodium hydroxide reacts with weak acids such as hydrogen sulfide and mercaptans to give the non-volatile sodium salts which can be removed. The waste which is formed is toxic and difficult to deal with, and the process is banned in many countries because of this. In 2006, Trafigura used the process and then dumped the waste in Africa.[13]

### 1.2.3.1 Chemical pulping:

Sodium hydroxide is also widely used in pulping of wood for making paper.

Along with sodium sulfide, sodium hydroxide is a key component of the white liquor solution used to separate lignin from cellulosefibers in the Kraft process. It also plays a key role in several later stages of the process of bleaching the brown pulp resulting from the pulping process. These stages include oxygen delignification, oxidative extraction, and simple extraction, all of which require a strong alkaline environment with a pH > 10.5 at the end of the stages.[6]

### 1.2.3.2 Tissue digestion:

In a similar fashion, sodium hydroxide is used to digest tissues, such as in a process that was used with farm animals at one time. This process involved placing a carcass into a sealed chamber, then adding a mixture of sodium hydroxide and water (which breaks the chemical bonds that keep the flesh intact). This eventually turns the body into a liquid with coffee-like appearance, and the only solid that remains are bone hulls, which could be crushed between one's fingertips Sodium hydroxide is frequently used in the process of decomposing roadkill dumped in landfills by animal disposal contractors, Due to its low cost and availability, it has been used to dispose of corpses by criminals.

Italianserial killerLeonardo Cianciulli used this chemical to turn dead bodies into soap. In Mexico, a man who worked for drug cartels admitted disposing over 300 bodies with it.[16]

#### 1.2.3.3Etherification and transesterification reagent:

Sodium hydroxide is traditionally used in soap making (cold process soap, saponification, It was made in the nineteenth century for a hard surface rather than liquid product because it was easier to store and transport.

For the manufacture of biodiesel, sodium hydroxide is used as a catalyst for the transesterification of methanol and triglycerides. This only works with anhydrous sodium hydroxide, because combined with water the fat would turn into soap, which would be tainted with methanol. It is used more often than potassium hydroxide because it is cheaper and a smaller quantity is needed.

Sodium hydroxide is also being used experimentally in a new technology to create synthetic gasoline.[5]

#### 1.2.3.4 Food preparation:

Food uses of sodium hydroxide include washing or chemical peeling of fruits and vegetables, chocolate and cocoa processing, caramel coloring production, poultry scalding, soft drink processing, and thickening ice cream. Olives are often soaked in sodium hydroxide for softening; Pretzels and Germanlye rolls are glazed with a sodium hydroxide solution before baking to make them crisp. Owing to the difficulty in obtaining food grade sodium hydroxide in small quantities for home use, sodium carbonate is often used in place of sodium hydroxide.[2],[15]

### 1.2.3.5 Cleaning agent:

Sodiumhydroxide frequently used as an industrial cleaning agent where it is often called "caustic". It is added to water, heated, and then used to clean process equipment, storage tanks, etc. It can dissolve .waste discharge pipes under sinks and drains in domestic properties. Surfactants can be added to the sodium hydroxide solution in order to stabilize dissolved substances and thus prevent redeposition. A sodium hydroxide soak solution is used as a powerful degreaser on stainless steel and glass bake ware. It is also a common ingredient in oven cleaners.

A common use of sodium hydroxide is in the production of parts washerdetergents. Parts washer detergents based on sodium hydroxide are some of the most aggressive parts washer cleaning chemicals. The sodium hydroxide based detergent includes surfactants, rust inhibitors and defamers. A parts washer heats water and the detergent in a closed cabinet and then sprays the heated sodium hydroxide and hot water at pressure against dirty parts for degreasing applications. Sodium hydroxide used in this manner replaced many solvent based systems in the early 1990s when trichloroethane was outlawed by the Montreal Protocol[11].

**Figure 1.2 shows the grade sodium hydroxide to be used as a type of drain cleaners[1]**

### 1.2.4 Historical uses:

Sodium hydroxide has been used for detection of carbon monoxide poisoning, with blood samples of such patients turning to a vermilion color upon the addition of a few drops of sodium hydroxide [14]

### 1.2.5 Safety:

Chemical burns caused by sodium hydroxide solution photographed 44 hours after exposure.

Like other corrosiveacids and alkalis, drops of sodium hydroxide solutions can decompose proteins and lipids in skin, eyes or other living tissues by amide hydrolysis and ester hydrolysis, which consequently causes chemical burns and may induce permanent blindness if it contacts eyes. Solid alkali may also express its corrosive nature if there is water, so protective equipment such as rubber gloves, safety clothing and eye protection should always be used when handling the material or its solutions.[14]

Moreover, dissolution of sodium hydroxide is highly exothermic, and the resulting heat may cause heat burns or ignite flammables. It also produces heat when reacted with acids.

The standard first aid measures for alkali spills on the skin is, as for other corrosives, irrigation with large quantities of water. Washing is continued for at least ten to fifteen minutes.[7],[8]

### 1.2.6 Production:

Sodium hydroxide is industrially produced as a 50% solution by variations of the electrolytic chloro alkali process. Chlorine gas is also produced in this process. Solid sodium hydroxide is obtained from this solution by the evaporation of water. Solid sodium hydroxide is most commonly sold as flakes, prills, and cast blocks.

In 2004, world production was estimated at 60 million dry metric tons of sodium hydroxide, and demand was estimated at 51 million tones, In 1998, total world production was around 45 million tones. North America and Asia collectively contributed around 14 million tones, while Europe produced around 10 million tones. In the United States, the major producer of sodium hydroxide is the Dow Chemical Company, which has annual production around 3.7 million tones

All of these companies use the chloro alkali process.

Historically, sodium hydroxide was produced by treating sodium carbonate with calcium hydroxide in a metathesis reaction. (Sodium hydroxide is soluble while calcium carbonate is not.) This process was called causticizing.

$$Ca(OH)_{2(aq)} + Na_2CO_{3(s)} \rightarrow CaCO_3\downarrow + 2\ NaOH_{(aq)}$$

This process was superseded by the Solvay process in the late 19th century, which was in turn supplanted by the chloro alkali process which we use today.

Sodium hydroxide is also produced by combining pure sodium metal with water. The byproducts are hydrogen gas and heat, often resulting in a flame, making this a common demonstration of the reactivity of alkali metals in academic environments; however, it is not commercially viable, as the isolation of sodium metal is typically performed by reduction or electrolysis of sodium compounds including sodium hydroxide.[7][12]

## 1.3 Natron

Natron is a naturally occurring mixture of sodium carbonatedecahydrate ($Na_2CO_3 \cdot 10H_2O$, a kind of soda ash) and about 17% sodium bicarbonate (also called nahcolite, or baking soda, $NaHCO_3$) along with small quantities of sodium chloride and sodium sulfate. Natron is white to colourless when pure, varying to gray or yellow with impurities.

Natron deposits are sometimes found in saline lake beds which arose in arid environments. Throughout history natron has had many practical applications which continue in the wide range of modern uses of its constituent mineral components.

In modern mineralogy the term natron has come to mean only the sodium carbonate decahydrate (hydrated soda ash) which makes up most of the historical salt.[20]

## 1.4Calcium oxide (quick lime):

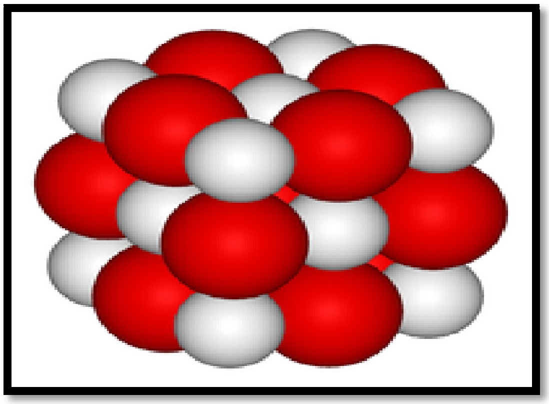


**Figure 1.3: shows the structure of quick lime**

### 1.4.1 Properties:

| | |
|---|---|
| Molecular formula | CaO |
| Molar mass | 56.0774 g/mol |
| Appearance | White to pale yellow/brown powder |
| Odor | Odorless |
| Density | 3.34 g/cm$^3$[1] |
| Melting point | 2613 °C, 2886 K, 4735 °F[1] |

Calcium oxide (CaO), commonly known as quicklime or burnt lime, is a widely used chemical compound. It is a white, caustic, alkaline, crystalline solid at room temperature. The broadly used term "lime" connotes calcium-containing inorganic materials, which include carbonates, oxides and hydroxides of calcium, silicon, magnesium, aluminum, and iron predominate, such as limestone. By contrast, "quicklime" specifically applies to the single chemical compound calcium oxide. Calcium oxide which survives processing without reacting in building products such as cement is called free lime.

Quicklime is relatively inexpensive. Both it and a chemical derivative (calcium hydroxide, of which quicklime is the base anhydride) are important commodity chemicals. [20]

### 1.4.2 Preparation:

Calciumoxide is usually made by the thermal decomposition of materials such as limestone, or seashells, that contain calcium carbonate ($CaCO_3$; mineral calcite) in a lime kiln. This is accomplished by heating the material to above 825 °C (1,517 °F), a process called calcination or lime-burning, to liberate a molecule of carbon dioxide ($CO_2$); leaving quicklime. The quicklime is not stable and, when cooled, will spontaneously react with $CO_2$ from the air until, after enough time, it will be completely converted back to calcium carbonate unless slaked with water to set as lime plaster or lime mortar.

Annual worldwide production of quicklime is around 283 million metric tons. China is by far the world's largest producer, with a total of around 170 million tones per year. The United States is the next largest, with around 20 million tones per year.

### 1.4.3 Usage:

**Heat**: Quicklime produces heatenergy by the formation of the hydrate, calcium hydroxide

$$CaO_{(s)} + H_2O_{(l)} \rightleftharpoons Ca(OH)_{2(aq)} \ (\Delta H = -63.7 \text{ kJ/mol of CaO})$$

As it hydrates, an exothermic reaction results and the solid puffs up. The hydrate can be reconverted to quicklime by removing the water by heating it to redness to reverse the hydration reaction. One litre of water combines with approximately 3.1 kilograms (6.8 lb) of quicklime to give calcium hydroxide plus 3.54 MJ of energy. This process can be used to provide a convenient portable source of heat, as for on-the-spot food warming in a self-heating can.

**Light**: When quicklime is heated to 2,400 °C (4,350 °F), it emits an intense glow. This form of illumination is known as a limelight, and was used broadly in theatrical productions prior to the invention of electric lighting.

**Cement**: Calcium oxide is a key ingredient for the process of making cement.

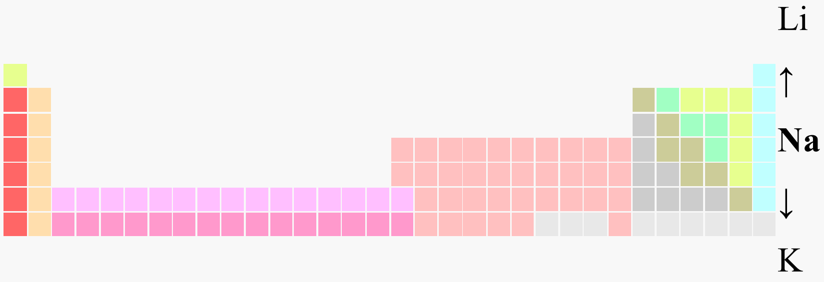
**Petroleum industry**: Water detection pastes contain a mix of calcium oxide and phenolphthalein. Should this paste come into contact with water in a fuel storage tank, the CaO reacts with the water to form calcium hydroxide.

Calcium hydroxide has a high enough pH to turn the phenolphthalein a vivid purplish-pink color, thus indicating the presence of water. [20]

## 1.5 Sodium:

**Sodium**

$_{11}$**Na**



neon ← **sodium** → magnesium

**Figure 1.4 position of sodium in period table**

Sodium is a chemical element with the symbol Na (from Latin: natrium) and atomic number 11. It is a soft, silver-white, highly reactive metal and is a member of the alkali metals; its only stable isotope is 23Na. The free metal does not occur in nature, but instead must be prepared from its compounds; it was first isolated by Humphrey Davy in 1807 by the electrolysis of sodium hydroxide. Sodium is the sixth most abundant element in the Earth's crust, and exists in numerous minerals such as feldspars, sodality and rock salt (NaCl). Many salts of sodium are highly water-soluble, and their sodium has been leached by the action of water so that sodium and chlorine (Cl) are the most common dissolved elements by weight in the Earth's bodies of oceanic water. [20]

### 1.5.2 Properties:

| | |
|---|---|
| **Phase** | solid |
| **Density (near r.t.)** | 0.968 g·cm$^{-3}$ |
| **Liquid density at m.p.** | 0.927 g·cm$^{-3}$ |
| **Melting point** | 370.944 K208.029 °F  97.794 °C,  , |
| **Boiling point** | 1621.292 °F  882.940 °C,<br>1156.090 K, |
| **Critical point** | (extrapolated)<br>2573 K, 35 MPa |
| **Heat of fusion** | 2.60 kJ·mol$^{-1}$ |

## 1.6 Calcium:

Calcium is the chemical element with symbol Ca and atomic number 20. Calcium is asoft gray alkaline earth metal ,and is the fifth-most-abundant element by mass in the Earth crust

Calcium is also the fifth –most-abundant dissolved ion in sea water by both molarity and mass, after sodium,chloride, magnesium,and sulfate.

Calcium is essential for living organisms, in particular in cell physiology, where movement of the calcium ion Ca+2 into and out of the cytoplasm functions as asignal for many cellular processes. As amajor material used in mineralization of bone, teeth and shell, calcium is the most abundant metal by mass in many animals.[20]

## 1.7 Iron

Iron is a chemical element with the symbol Fe (from latin :ferrum) and atomic number 26.

It is metal in the first Transition series It is by mass the most common element on earth, forming much of earth outer and inner core.

It is the fourth most common element in the earth crust, it is abundance in rocky planets like earth.

Iron metal has been used since time, though copper alloys,which have lower melting temperatures,were used even earlier In human History.[20]

## 1.7 Instruments:

### 1.7.1 Introduction:

Atomic spectroscopy is thought to be the oldest instrumental method for the determination of elements. These techniques are introduced in the mid of 19th Century during which Bunsen and Kirchhoff showed that the radiation emitted from the flames depends on the characteristic element present in the flame. The potential of atomic spectroscopy in both the qualitative as well as quantitative analysis were then well established. The developments in the instrumentation area led to the widespread application of atomic spectroscopy. Atomic spectroscopy is an unavoidable tool in the field of analytical chemistry. It is divided into three types which are absorption, emission, and luminescence spectroscopy. The different branches of atomic absorption spectroscopy are (1) Flame photometry or flame atomic emission spectrometry in which the species is examined in the form of atoms (2) Atomic absorption spectrophotometry, (AAS), (3) Inductively coupled plasma-atomic emission spectrometry (ICP-AES).[15]

### 1.7.2 Flame photometer:

Photoelectric flame photometry, a branch of atomic spectroscopy is used for inorganic chemical analysis for determining the concentration of certain metal ions such as sodium, potassium, lithium, calcium, Cesium, etc. In flame photometry the species (metal ions) used in the spectrum are in the form of atoms. The International Union of Pure and Applied Chemistry (IUPAC) Committee on Spectroscopic Nomenclature has recommended it as flame atomic emission spectrometry (FAES). The basis of flame photometric working is that, the species of alkali metals(Group 1) and alkaline earth metals (Group II) metals are dissociated due to the thermal energy provided by the flame source. Due to this thermal excitation, some of the atoms are excited to a higher energy level where they are not stable. The absorbance of light due to the electrons excitation can be measured by using the direct absorption techniques. The subsequent loss of energy will result in the movement of excited atoms to the low energy ground state with emission of some radiations, which can be visualized in the visible region of the spectrum. The absorbance of light due to the electrons excitation can be measured by using the direct absorption techniques while the emitting radiation intensity is measured using the emission techniques. The wavelength of emitted light is specific for specific elements.

**Figure 1.5 Parts of a flame photometer**

- **Source of flame:**

A burner that provides flame and can be maintained in a constant form and at a constant temperature.

- **Nebulizer and mixing chamber**:

Helps to transport thehomogeneous solution of the substance into the flame at a steady rate.

- **Optical system (optical filter)**:

The optical system comprises three parts: convex mirror, lens and filter. The convex mirror helps to transmit light emitted from the atoms and focus the emissions to the lens. The convex lens help to focus the light on a point called slit. The reflections from the mirror pass through the slit and reach the filters. This will isolate the wavelength to be measured from that of any other extraneous emissions. Hence it acts as interference type color filters.

- **Photo detector**:

Detect the emitted light and measure the intensity of radiation emitted by the flame. That is, the emitted radiation is converted to an electrical signal with the help of photo detector. The produced electrical signals are directly proportional to the intensity of light.

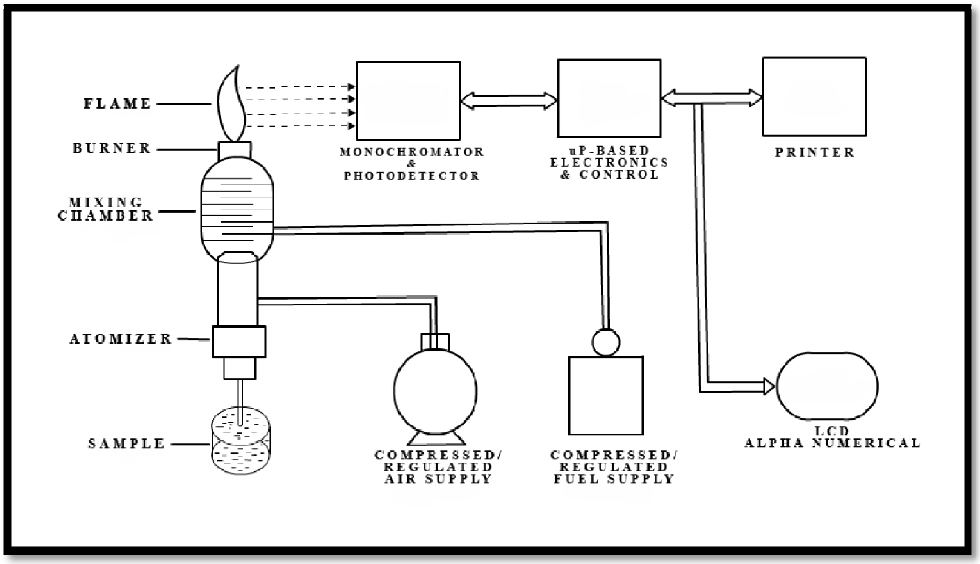


Figure 1.6: A schematic representation of flame photometer

### 1.7.2.1 Mechanism of working:

The working of the flame photometer involves a series of steps which is discussed in the following sections.

*** Nebulization:**

The solution of the substance to be analyzed is first aspirated into the burner, which is then dispersed into the flame as fine spray particles.

***A brief overview of the process:**

1. The solvent is first evaporated leaving fine divided solid particles.
2. This solid particles move towards the flame, where the gaseous atoms and ions are produced.
3. The ions absorb the energy from the flame and excited to high energy levels.
4. When the atoms return to the ground state radiation of the characteristic element is emitted.
5. The intensity of emitted light is related to the concentration of the element.[15]

### 1.7.3 Atomic absorption spectroscopy (AAS):

Atomic absorption is the determination of the presence and concentrations of metals in liquid samples. Metals include Fe, Cu, Al, Pb, Ca, Zn, Cd and many more. Typical concentrations range in the low mg/L (ppm) range.

In atomic absorption (AA) spectrometry, light of a specific wavelength is passed through the atomic vapor of an element of interest, and measurement is made of the attenuation of the intensity of the light as a result of absorption.

**Quantitative analysis by AA depends on:**

(1) Accurate measurement of the light intensity.

(2) The radiation absorbed must be proportional to the atomic concentration.

Metals will absorb ultraviolet light in their elemental form when they are excited by heat, either by flame or graphite furnace. Each metal has a characteristic wavelength that will be absorbed. The AAS instrument looks for a particular metal by focusing a beam of uv light at a specific wavelength through a flame and into a detector.

The sample of interest is aspirated into the flame. If that metal is present in the sample, it will absorb some of the light, thus reducing its intensity. The instrument measures the change in intensity. A computer data system converts the change in intensity into an absorbance.

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**The following components make up the AA spectrometer:**

*** Hollow cathode lamp:**

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***Hollow cathode lamp:**

Source of the analytical light line for the element of interest give aconstant and intense beam of that analytical line.

- **Nebulizer**

Suck up liquid sample at a controlled rate create a fine aerosol spray for introduction into the flame Mix the aerosol and fuel and oxidant thoroughly for introduction into the flame.

- **Flame**

Destroy any analyte ions and breakdown complexes create atoms of the element of interest, Feo, Cuo, Zno, etc.

- **Monochromator**

Isolate the analytical line photons passing through the flame Remove scattered light of other wavelengths from the flame In doing this, only a narrow spectral line impinges on the PMT.

- **Photomultiplier tube (PMT)**

This is the detector. The PMT determines the intensity of photons of the analytical line exiting the monochromator. The PMT is the most commonly used detector for atomic absorption spectroscopy. However, solid state detectors are now replacing conventional vacuum-type photomultipliers.

High tech electronics amplify, filter, and process the electrical signal, using a series of chips and microprocessors, transmitting the result to an internal or external computer which handle all data-handling .[15]

# Material and Methods

## 1.2Sample:

A synthetic sample was prepared in the laboratory by dissolving of 50g of natron dissolved in warm water and diluted to 250ml then the solution was filtrated and the volume was complete to 250ml.

## 2.2 Chemicals:

- Distilled water.

- Hydro chloric acid, HCL, 11.8M,(1.18g/cm$^3$),36.5%,36.46g/mol.

- Quick lime,CaO, local shop.

- Natron, local shop.

- Ph. Ph indicator.

- Sodium carbonate,$Na_2CO_3$,0.5M.

**Equipment:**

- Beaker (50,100,250ml).
- Conical flask 250ml.
- Sensitive balance.
- Glass rode.
- Volumetric flask 250ml.
- Burette.
- Pipette.
- Funnel.
- Filter paper.
- Heater.

**Instruments:**

- Flame photometer.
- Atomic absorption.

## 3.2 Preparation of Solution:

### 3.2.1 Preparation of hydrochloric acid:

8.5 ml of hydrochloric acid,was transferred to volumetric flask 100ml and diluted to mark by distilled water.

### 3.2.2Standardization of hydrochloric acid:

5ml of hydrochloric acid, was transferred to conical flask 250 ml 2drops of ph.ph indicator was added and titrated against sodium carbonate (0.5M).

### 3.2.3 Determination of carbonate in natronsample:

5ml of synthetic sample was transferred to conical flask 250 ml , 2drops of ph.ph indicator was added and titrated against hydrochloric acid which standardization .

### 3.2.4Determination of sodium in natronsample:

1ml of synthetic sample was diluted to 250ml, 5ml of this solution was diluted to 100ml, and sodium concentration was found by use flame photometer.

### 3.2.5Determination of potassium in natron sample:

1ml of synthetic sample was diluted to 250ml and the concentration was found by use flame photometer.

### 3.2.6Determination of iron in natron sample:

1ml of synthetic sample was diluted to 250ml and the concentration was found by use atomic absorption.

### 3.2.7 Determination of silica in natron sample:

In preparation of synthetic sample step the precipitate was weighed.

### 3.2.8 Preparation of sodium hydroxide (by using quick lime):

5g of quick lime was weighted and added (slowly with shaking ) to 50ml of synthetic sample , then the mixture was heated in water path after that the mixture was filtrated to take out in soluble quicklime, the step of preparation of sodium hydroxide was repeated by using 10g of quick lime.

### 3.2.9 Determination of sodium hydroxide concentration:

5ml of sodium hydroxide solution (which is prepared in last step), was transferred to conical flask 250 ml, 2drops of ph.ph indicator was added and titrated against hydrochloric acid(1M) .

### 3.2.10 Determination of sodium in sodium hydroxide:

1ml of sodium hydroxide (which is prepared by using 5gquick lime ) was diluted to 100ml,1 ml of this solution was diluted to 100ml , and the concentration was found by use flame photometer, the step was repeated by using sodium hydroxide which is prepared by using 10g of quick lime.

### 3.2.11Determination of potassium in sodium hydroxide:

1ml of sodium hydroxide (which is prepared by using 5g quick lime) was diluted to 100ml,2 ml of this solution was diluted to 10ml, and the concentration was found by use flame photometer.

The step was repeated by using sodium hydroxide which is prepared by using 10g of quick lime.

# Results

## 3.1Standardization of hydrochloric acid:

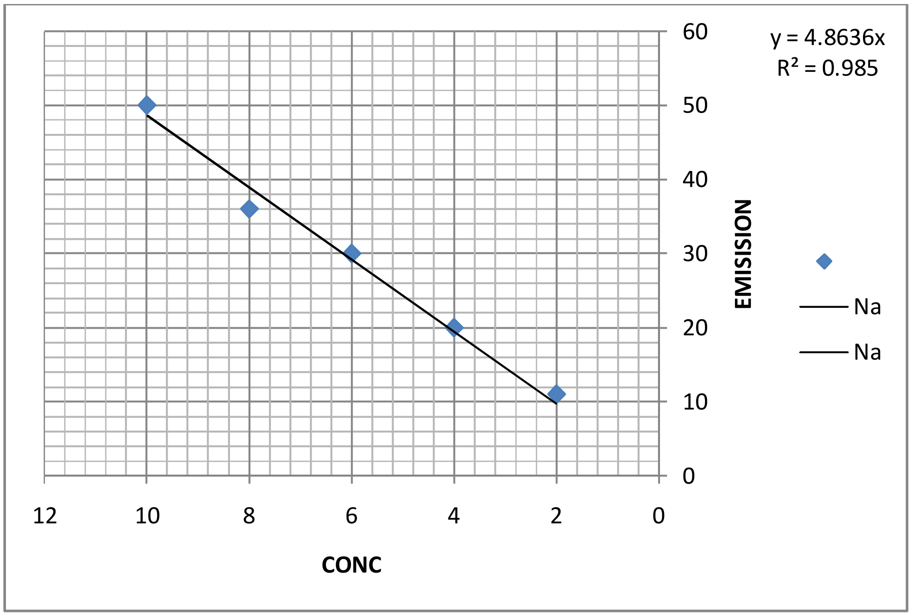
| $V_1$/cm$^3$ | $V_2$/cm$^3$ | v/cm$^3$ |
|---|---|---|
| 11.10 | 16.10 | 5.00 |
| 16.10 | 21.00 | 4.90 |

### 3.2 Determination of carbonate in natron sample:

| $V_1$/cm$^3$ | $V_2$/cm$^3$ | v/cm$^3$ |
|---|---|---|
| 15.60 | 22.10 | 6.50 |
| 22.10 | 28.60 | 6.50 |

## 3.3Determination of sodium in natron sample:

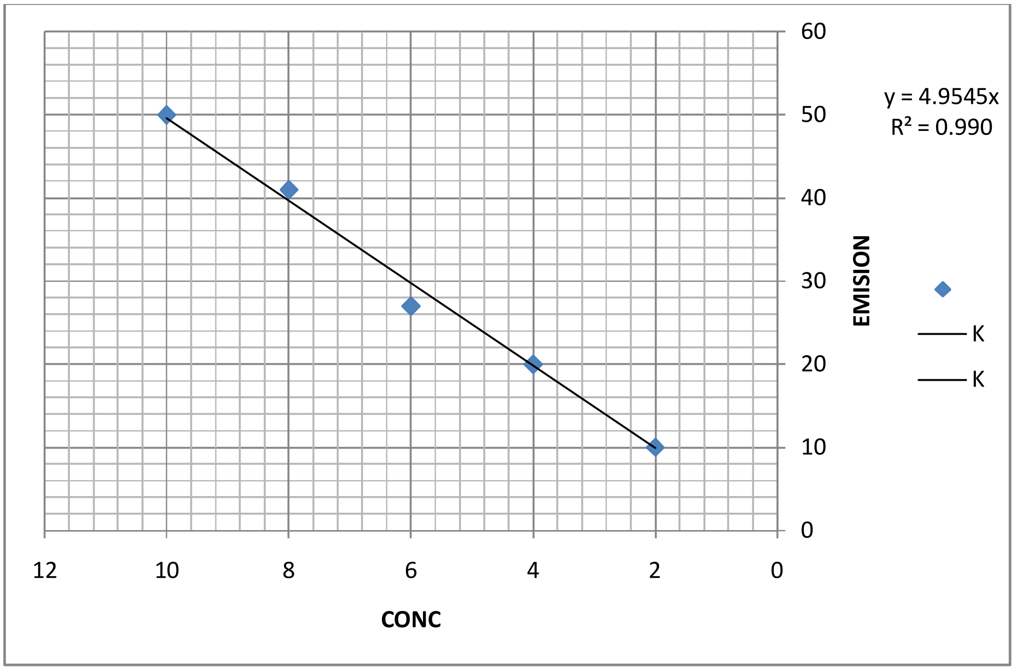
| C/ppm | E |
|---|---|
| 10 | 50 |
| 8 | 36 |
| 6 | 30 |
| 4 | 20 |
| 2 | 11 |
| Un | 40 |



**3.1 Graph explain the relation between concentration and emission to determine the concentration of sodium in natron.**

## 3.4Determination of potassium in natron sample:

| c/ppm | E |
|---|---|
| 10 | 50 |
| 8 | 40 |
| 6 | 27 |
| 4 | 18 |
| 2 | 11 |
| Un | 20 |



***3.2* Graph explain the relation between concentration and emission to determine the concentration of potassium in natron.**

## 3.5Determination of iron in natron sample:

| | Action | Sample ID | True value | Conc/ppm | Abs | DF | Actual Conc |
|---|---|---|---|---|---|---|---|
| *5* | BLK-Au | - | - | - | 0.0011 | - | - |
| *8* | STD-AV | STD1 | 0.0000 | - | 0.0002 | - | - |
| *14* | STD-AV | STD2 | 1.0000 | - | 0.0316 | - | - |
| 17 | STD-AV | STD3 | 3.0000 | - | 0.060 | - | - |
| 20 | STD-AV | STD4 | 5.0000 | - | 0.1419 | - | - |
| 23 | STD-AV | STD5 | 7.0000 | - | 0.1994 | - | - |
| 46 | Un $k_3$ | - | - | 0.0000 | 0.0000 | 1.00 | 0.0000 |

## 3.6 Determination of silica in natron sample:

| Weight of filter paper(g) | Weight of filter paper +Silica(g) | Weight of Silica(g) |
|---|---|---|
| 1.04 | 5.64 | 4.60 |

| Weight of natron+ Silica(g) | Weight of Silica(g) | Weight of natron(g) |
|---|---|---|
| 50.00 | 4.60 | 45.40 |

### 3.7 Determination of sodium hydroxide concentration:

1-(which is prepared by using 5g quick lime):

| $V_1$/cm$^3$ | $V_2$/cm$^3$ | $V_2$/cm$^3$ |
|---|---|---|
| 00.00 | 15.40 | 15.40 |
| 15.40 | 30.80 | 15.40 |

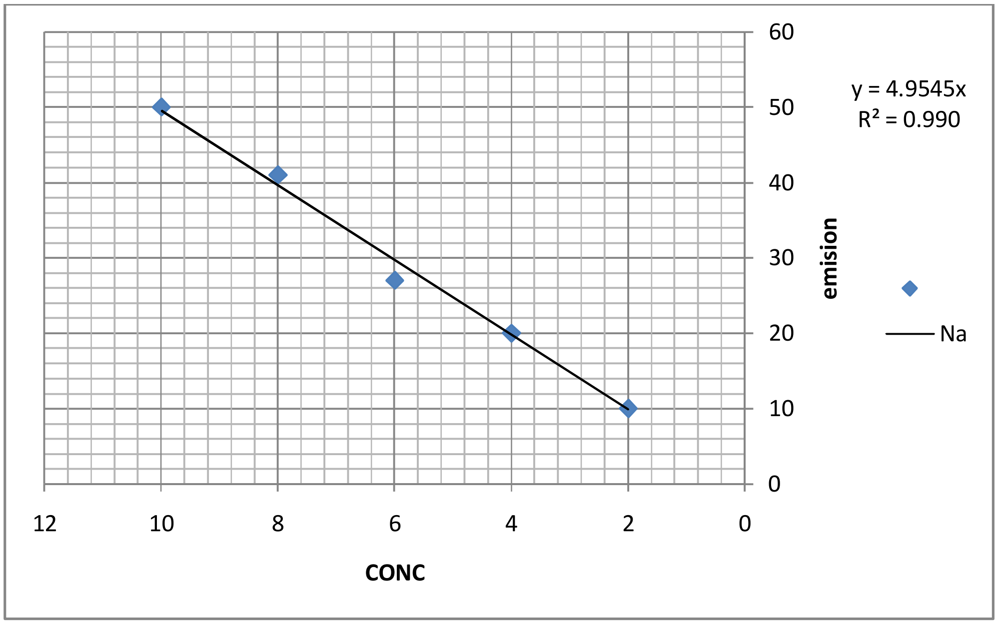
2-(which is prepared by using 10g quicklime):

| $V_1$/cm$^3$ | $V_2$/cm$^3$ | $V_2$/cm$^3$ |
|---|---|---|
| 2.00 | 19.00 | 17.00 |
| 22.50 | 39.50 | 17.00 |

## 3.8 Determination of sodium in sodium hydroxide:

1-(which is prepared by using 5g quicklime)

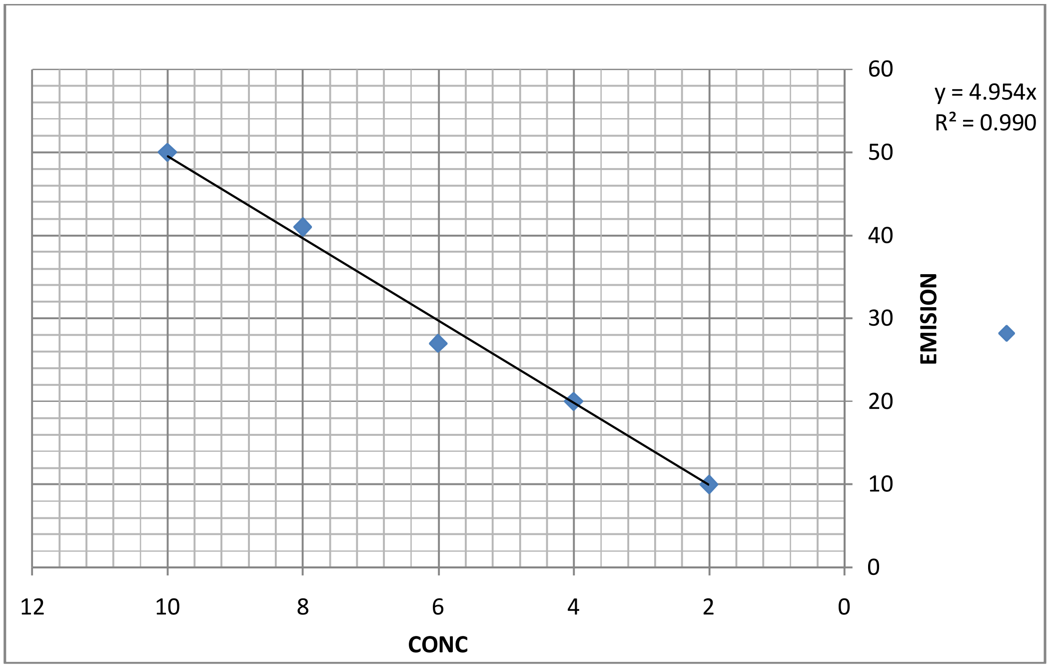
| C/ppm | E |
|---|---|
| 10 | 50 |
| 8 | 38 |
| 6 | 30 |
| 4 | 20 |
| 2 | 10 |
| C un | 36 |



**3.3 Graph explain the relation between concentration and emission to determine the concentration of sodium in sodium hydroxide.**

**2-(which is prepared by using 10g quick lime):**

| C/ppm | E |
|---|---|
| 10 | 50 |
| 8 | 38 |
| 6 | 30 |
| 4 | 20 |
| 2 | 13 |
| C un | 29 |

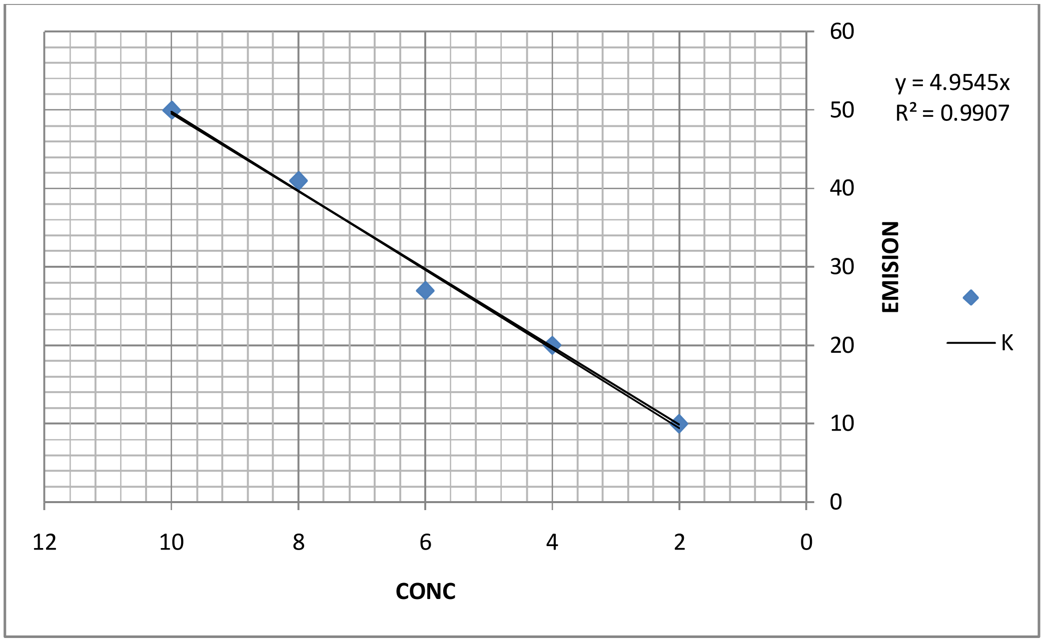


**3.4 Graph explain the relation between concentration and emission to determine the concentration of sodium in sodium hydroxide.**

## 3.9 Determination of potassium in sodium hydroxide:

### 1-(which is prepared by using 5g lime stone):

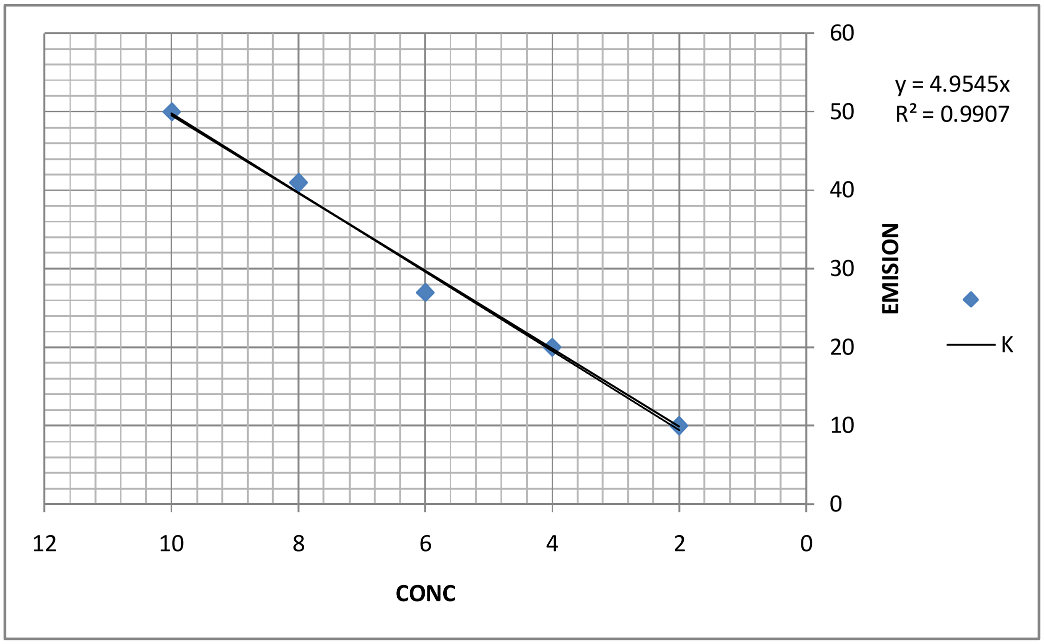
| C/ppm | E |
|---|---|
| 10 | 50 |
| 8 | 41 |
| 6 | 27 |
| 4 | 20 |
| 2 | 10 |
| Cun | 14 |



**3.5 graph explain the relation between concentration and emission to determine the concentration of potassium in sodium hydroxide.**

2-(which is prepared by using 10g lime stone):

| C/ppm | E |
|---|---|
| 10 | 50 |
| 8 | 41 |
| 6 | 27 |
| 4 | 20 |
| 2 | 10 |
| C un | 11 |



**3.6 Graph explain the relation between concentration and emission to determine the concentration of potassium in sodium hydroxide.**

## Discussion:

(3.08 M)Sodium hydroxide was prepared by using 5g of quick lime ,and 3.4M sodium hydroxide solution witch prepared by using 10g of quick lime, that can be refiared to the fact that rate of reaction increase in reacting material, the solution was heated to dissolved the quick lime with care to don't reath the poiling point because that can cause precipitate of natron.

The filtration was done to separate the precipitate of calcium carbonate.

The percentage of iron equal zero that main the percentage of carbonate is high.

The precipitate of calcium carbonate it can be used anther time after burning it, and refer to calcium oxide, and we can used it to prepared sodium hydroxide anther time.

## Calculation:

Standardization of hydrochloric acid:

$(M.V/n)Hcl=(M.V/n)Na_2CO_3$

$(M\times5/2)=(0.5\times4.95/1)$

$M=2\times0.5\times4.95/5$

M Hcl= 0.99M

**Determination of carbonate in natron sample:**

$(M\times V/n)Hcl=(M\times V/n)Na_2CO_3$

$(M\times5/1)Na2CO3=(1\times6.50/2)HCL$

$M=1\times6.50/10$

M=0.65M

Mole of $Na_2CO_3=0.65\times5/1000$

NO.Mole of $Na_2CO_3$=0.00325mole

0.00325→5ml

X → 250ml

X=0.162 mole

Weight=number of mole× M.wt

=0.162×106= 17.22g

%= 17.22/45 ×100 →%$Na_2CO_3$=38.27%

**Determination of silica in natron:**

Percentage in natron= weight of silica/weightof sample ×100

**4**.60/50 ×100

% of silica = 9.2 %

**Determination of iron in natron sample:**

The percentage of iron =zero

**Determination of sodium in natron:**

$Y = 4.8636X$

$40= 4.8636 X$

$X = 8.22$ ppm.

X ≡concentration.

y≡ emission .

**Determination of potassium in natron:**

$Y=4.9545 X$

$20= 4.9545 X$

$X= 4$ ppm

X ≡concentration.

y≡ emission .

**Determination of sodium hydroxide concentration:**

**1-(which is prepared by using 5g quick lime:**

$(M\times V/n)Hcl = (M\times V/n)\ NaoH$

$0.99\times 15.40=M\times 5$

$MNaoH = 3.08M$

**2-(which is prepared by using 10g quick lime)**

$(M\times V/n)Hcl = (M\times V/n)\ NaoH$

$0.99\times 17.00=M\times 5$

$MNaoH = 3.40M$

**Determination of sodium in sodium hydroxide:**

**1-(which is prepared by using 5g quick lime):**

Y =4.9545 X
36=4.9545 X
X= 7.266 ppm

**2-(which is prepared by using 10g quick lime):**

Y = 4.9545 X

29= 4.9545 X

X= 5.8 ppm

**Determination of potassium in sodium hydroxide:**

**1-(which is prepared by using 5g quick lime):**

Y =4.9545 X

14= 4.9545 X

X= 2.8 ppm

**2-(which is prepared by using 10g quick lime):**

Y= 4.9545 X

11 =4.9545 X

X= 2.22 ppm

## Conclusion:

The experiment has been done ,sodium hydroxide solution (3.08M) has been prepared from quick lime 5g and (3.4M) sodium hydroxide from quick lime 10g and natron has been used with( 38.27%) carbonate.

## Recommendation:

The produce is easy,simple un cost economical and sodium hydroxide has been producer from available raw material in nature and un harmful

Is better to use natron with higher percentage of carbonate to get higher concentration from sodium hydroxide,and yield can be used in industry.

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